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BUSINESS INTELLIGENCE IN TRANSPORTATION LOGISTICS

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Abstract: *Transportation logistics is not any more limited only to the movement of goods across space and reducing time and costs along the supply chain. Its scope has expanded and now it is influencing decisions on what to produce, where to produce/store, in what quantities, who to choose for as the logistics provider, etc., which are parts of strategic management. These improvements in transportation logistics are in great a part result of new transportation and information technologies. To take right decisions we need timely and accurate information and reporting environments. We have to cope with a vast amount of business data (from disparate operating systems and applications), rapidly changing customer needs and market conditions, but also with a vast amount of hidden information (documents, e-mails, know-how, voice records, external sources etc.). Therefore, we need integration of our core business information system with a set of intelligent tools, intelligent information systems and modern analytical and artificial intelligence tools to discover relevant knowledge from all of these sources, to manage uncertainty, and to create and reach our business intelligence as our main competitive advantage. In this paper the concept of business intelligence and some artificial intelligence tools will be presented and their use in transportation logistics will be discussed.*

Keywords*: business intelligence, transportation logistics, artificial intelligence, knowledge discovery, data mining, neural networks, modern analytical tools, computer simulation, planning and scheduling tools, artificial cognitive vision.*

1. INTRODUCTION

The streamline and optimization of business (logistics) processes and operations, minimization of transportation costs, shortening of delivering times, lowering of product and service prices, improving customer satisfaction, and maximization of supply chain technology have always been primary goals of every business subject. As a result of globalization and integration of different economies, and the formation of international global supply chains and clusters their importance has increase further. And today, in the period of recession, their importance has now reached the highest level.

One of the most significant factors influencing the realization of these goals and way of doing business and collaborating with trading partners effectively is information and communication technology, which enables fast and reliable internal and external communication, permanent storing of business data and activities needed for current business and planning future business activities. In uncertain environments, where data from external sources is needed for strategic planning, it is even more important that we know to explore all these data, process them in the way to produce knowledge and find hidden patterns, relationships and correlations that help us in strategic decision making, forecasting trends and possibilities.

These capabilities, related technologies and tools are seen as promising future technologies [3] and prerequisites to survive or beat the

recession [5]. Business intelligence, data content, and data knowledge are emerging technologies that are expected to have innovative potential in the next years.

This paper on business intelligence in transportation logistics attempts to emphasize the importance of integration of business intelligence with transport systems as an important element of the logistics system. The role of transportation logistics in the logistics system is discussed in Section 2. An overview of business intelligence, how to implement it, and benefits we can derive from it, are discussed in Section 3. Some of the most important applications of business intelligence in the transport system are explored in Section 4. The paper concludes by highlighting some potential trends of integration of business intelligence in transportation logistics and the future of business intelligence.

2. IMPORTANCE OF THE TRANSPORTATION LOGISTICS IN THE LOGISTICS SYSTEM

The transportation system is the key element in a logistics chain because it provides links among separated logistics activities. If our aim is to take full advantage of logistics, we have to have a well developed, efficient and effective transportation system. The influence of the transportation system on the logistics system is the logical consequence of the fact that transportation generates one-third of the amount in the logistics cost. [11]

According to the [2] the objective of transportation logistics, as one component of integrated logistics management, is to compress time along the whole supply chain. It means a reduction of delivery time in shipments from suppliers of raw materials, intermediate goods and components to factories, distribution of final products from factories to wholesalers, retailers and end users, and the distribution of spare parts for after-sales services. Nevertheless, transportation logistics has ceased to be limited only to the movement of goods across space and reducing time and costs along the supply chain. Its scope has expanded and now it is influencing decisions on what to produce, where to produce/store, in what quantities, who to choose as the logistics provider, etc., which are parts of strategic management. These improvements in transportation logistics are in great part results of new transportation and information technologies.

3. OVERVIEW OF BUSINESS INTELLIGENCE TOOLS AND TECHNOLOGIES

Definition of business intelligence

Summarizing numerous definitions of business intelligence we can say that business intelligence is a set of intelligent (software) tools and systems that help (facilitate) a company to better understand, analyze, explore and predict what is occurring in the company and also in the broader environment. These tools and systems help the company to turn data, usually collected and saved in databases, into useful and meaningful information, which is then distributed to those who need it, when they need it, wherever they need it for improved and timely decision making. Business intelligence tools also allow a company to see, use and combine large amounts of complex data from different sources - internal and external, normalized or denormalized, structured and unstructured, and to represent the integration of these data in various reports and graphical 3D views.

Business intelligence helps a company not only to monitor its operations by querying, analyzing, reporting, performing in-depth analyses of what is going on, what helps find and resolve potential problems, identify and leverage new opportunities, predict and plan for the future, align the operations with strategic goals. Indeed, “Business intelligence usually refers to the information that is available for the enterprise to make decisions on”. [1] Because of this it has become a synonym for decision support. In addition, because of the fact that business intelligence is often (but not obligatorily) used with data warehousing it has also become a synonym for this term. However, data warehousing only is a component for achieving business intelligence.

Business intelligence tools

Business intelligence tools are tools commonly used for implementing business intelligence. This does not mean that business intelligence tools are making non-trivial decision by themselves. “Decisions are made only and business intelligence is garnered only with the combination of the output of the business intelligence tools, human judgment and intuition, and the ability to put the information spit out by tools into a context of information that is much wider than any data warehouse, transaction

processing system, knowledge repository can handle. [8] The term business intelligence tool represents software that enables business users to see and use large amounts of complex data. [7]

The spectrum of business intelligence tools and functionalities is very broad. They differ significantly regarding their cost, functionality, business intelligence complexity and number of total users. The most common business intelligence tools are as follows.

Spreadsheets

The most common, popular and used business intelligent tools are spreadsheets (or we can say Microsoft Excel files). The reasons for this are numerous: it is relatively cheap, easy to use, well known in the business area, it has/includes almost all functionalities that users need to display data, and quite all other reporting tools have export to Excel and Import from Excel. The most common use of Excel is reporting and goals tracking.

Query, reporting and data visualization tools

Answering predefined questions, a query tool offers to users a static view of information to be analyzed, combined with information from other sources or exported for use with other tools. The next group of tools are reporting tools that are either custom-built or commercial (the determination whether to buy or build a reporting tool has to based on a number of reports, the desired report distribution mode, and the need for ad hoc report creation). Reporting tools are more flexible compared to spreadsheets and enable each user to create, schedule and run their own reports. This is the software that allows the user to ask (ad hoc) questions about patterns or details in the data. Visualization tools include a set of graphical tools, dashboards and scoreboards. The most common application of visualization tools is the visual interpretation of complex data relationships that facilitate decision making.

OLAP tools

OLAP (On-Line Analytical Processing) tools are used for multidimensional analysis ("slicing and dicing" of the data). They provide users with the ability to look at the data from a variety of different dimensions. OLAP means also "the use of computers to run the on-going operation of a business" [7]

Data mining tools

"Data mining tools predict future trends and behaviors, allowing business to make proactive, knowledge-driven decisions." [9] A data mining tool is the software that automatically searches for significant patterns or correlations among different factors in the data using sophisticated statistical and other techniques. It comprises various artificial intelligence tools and techniques like neural networks, machine learning, genetic algorithms, decision trees, knowledge management, rule induction, information extraction and information retrieval systems and other.

Core business intelligence technology (query, reporting, interactive analysis) is used to view or analyze what is occurring or has already occurred (business operations reporting – weekly or monthly reports), while data mining and predictive analysis allow users to predict what may occur in the future (this ability can be a competitive advantage in today's uncertain economy and global crisis).

The selection of appropriate business intelligence tools

Before we select an appropriate set of business intelligence tools for our business we have to know our business intelligence needs. We have to decide what types of business intelligence tools we would like to have, then choose a right vendor, and finally implement these tools in our business in the right way.

When selecting a business intelligence product we have to consider a lot of important factors. Among them are specific product features, ease of use, ease of implementation and administration, scalability, user-interface options, the ability to access and integrate a wide variety of disparate data sources, strong search functionality, and how well it integrates into existing and future platform environment (integration with desktop software, operating system). [6]

When implementing business intelligence we can choose to do it gradually or "all at once". Gradual implementation means that we first implement tools for operational purposes like databases, reporting and analyzing tools, and when business users have become familiar with them and our business has grown up and expanded, in the second step we implement business intelligence tools for deeper analysis,

such as data warehousing and data mining. The strategy of implementation of business intelligence tools depends primarily on the funds at our disposal and also on the expertise or familiarity of business users with different software systems.

Before choosing a set of business intelligence tools that are most appropriate for our company we have to decide whether to buy or build them from scratch. According to various sources of business intelligence knowledge [1, 6, 7] when making the decision of building or purchasing a reporting tool we have to consider our requirements regarding the reports we need, the distribution mode of reports, and the need for ad hoc report creation. If there is a need for a high number of reports, then it is better to buy a reporting tool because it already has a report management system which makes maintenance and support functions easier. If users will access reports through a variety of different channels (not only email or using a browser), then buying a reporting tool, that comes packaged with these distribution modes, is probably the right decision. If we have users that are able to create their own ad hoc reports, then purchasing a reporting tool is a better decision.

4. BUSINESS INTELLIGENCE IN TRANS-PORTATION LOGISTICS

In Section 2 we considered that transportation affects the results of logistics activities and it influences production and sale. Therefore, minimization of transportation costs and maximization of services to the customers are very important. The implementation or uses of business intelligence tools can help in various ways to achieve these goals. Some of the applications of business intelligence in transportation business are listed below:

- Achieving a cost-effective means of transport.
  Business intelligence software can facilitate a fast and easy selection of the best means of transport considering a vast number of factors (the key factors to consider in selecting the means of transport are physical characteristics of the load, the number of loads to be moved, the distance to be covered, the required speed of movement, the required proof of delivery, cost of building/dismantling loads, packaging costs, space requirements, interface with other storage, transport and handling systems and housekeeping issues) and considering also historic data and past experience.
- Reducing transportation costs, increasing efficiencies, and improving customer service with route optimization – routing and scheduling.
  Route optimization software helps us route multiple vehicles (means of transport) simultaneously considering business rules regarding vehicle capacities, customer-committed time windows, vehicle costs, work day rules, pre-assignment of orders to vehicles and other.

- Cargo load optimization software helps us find the best loading patterns for the same shipments, select the best vehicle to match a given shipment, determine how many vehicles are needed for large shipments, determine the exact costs of shipments.

- Analyzing transport operations- routes can help us identify potential problems or inconsistencies in daily operations (or some departments), and compare costs of same shipments on different routes to establish the best one.

- Managing inventory efficiently and effectively by determining of the inventory level of a product or part.

- Managing orders efficiently and effectively to increase customer satisfaction.

- Recognizing trends and understanding how they affect the business.

- Evaluating the operations performed in the company (generating reports), evaluating strategic factors (internal and external) and identifying patterns of business and operational behavior (using data mining techniques).

- Identifying customers that are cutting back on their purchases so that special inducements can be offered to retain them.

- Implement dashboards and scoreboards so that executives and supervisors can quickly recognize operational exceptions or key performance indicators (KPI) that fall outside of accepted ranges. Some of the important

KPIs could be planning accuracy, capacity utilization, resource utilization, load balancing, route utilization, scheduling accuracy, vehicle availability, vehicle loading time, average transit time, cost of transportation per ton, on time vehicle arrival, vehicle unloading time, order receipt accuracy, percentage of goods damaged, total order delivery time, on time deliveries, goods delivery rate, transportation costs and other. [3, 5]

- Establishing and monitoring performance metrics and taking corrective actions if we see they will not be met.
- Comparing year-to-date sales for this year with last year and forecast sales for the entire year.
- Tracking customer orders.
- Integrating operational, spreadsheet, and historic data for analysis purposes to provide consistency for the organization.
- Providing business users with the ability to perform their own ad hoc analysis and reports.
- Aligning daily operations with strategic objectives and quickly recognizing when they are not in agreement.
- Analyzing transportation means to verify cost-effectiveness.
- Making independent analyses of marketplace transportation costs to determine if our freight rates are competitive and to negotiate lower transportation costs if we are outsourcing transportation services.
- Forecasting economic and service impacts as consequences of changes in our transportation model, which permits us to find the optimal operating strategy.

5. CONCLUSIONS

Today's demands in doing business are increasing every day, regardless of what kind of business a company is involved in. Companies are facing with keen competition, with the need for reducing operational, product and service costs, the need for increasing functionality, flexibility and the ability to take (make) right decisions, based on information gained from operational and historic data, in right time. It is important that users are able to explore and analyze data, make different reports, but it is also important they can predict the behavior of customers, products and processes. Business intelligence tools are tools that can help users to reach all these goals – via querying, reporting, analyzing, visualization, uncovering patterns and correlations and relationships hidden in data. But, the real future of the business intelligence is in right use of these tools. They have to be guided and used by users who understand the business, the data, and the general nature of the analytical methods involved and are familiar with the software environments.

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БИЗНЕС РАЗУЗНАВАНЕ В ТРАНСПОРТНАТА ЛОГИСТИКА

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Ключови думи: *бизнес разузнаване, транспортна логистика, изкуствен интелект, откриване на знания, невронни мрежи, съвременни аналитични инструменти, компютърна симулация, инструменти за планиране, изкуствено когнитивно зрение*
Анотация*: Транспортната логистика вече не се ограничава единствено в преноса на стоки и намаляването на времето и разходите по веригата на снабдяването. Мащабите на логистиката се разрастват и днес тя влияе на избора на вида, количеството, мястото на произвежданите стоки, складирането им и други въпроси, част от стратегическия мениджмънт. Тези подобрения в транспортната логистика се дължат в голяма степен на новите транспортни и информационни технологии. За вземането на правилните решения се нуждаем от навременна и точна информационна среда.*